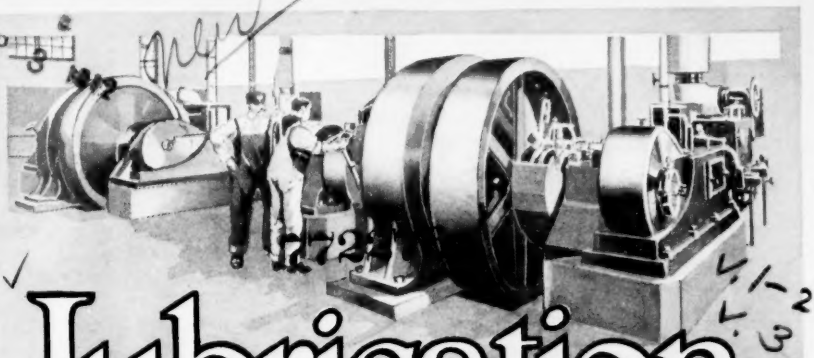

Lubrication

Aug. 1911
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CONTENTS

Editorial

Some Remarks on "Delaware" as a Cruiser Battleship

Heavy Duty Test

A Considerable Saving Effected in Thread Cutting Work

Frictional Heat Reductions

Oil Efficiency

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We invite correspondence from all those interested.

Those who fail to receive LUBRICATION promptly, will please notify us at once and will confer a favor by promptly reporting change of address.

CONTENTS

	Page
Editorial	1
Some Remarks on "Delaware" as a Cruiser Battleship	3
Heavy Duty Test	7
A Considerable Saving Effected in Thread Cutting Work	7
Frictional Heat Reduction	9
Oil Efficiency	10

LUBRICATION

With this first issue of our little magazine on lubrication, we would like to suggest some of the reasons for the publication of this book and the object which we have in view.

The practice of lubrication properly considered is one of the important points in the question of all production which involves moving mechanical appliances of any kind and enters into almost every character of business. It has been long understood that a considerable proportion of the power developed in any prime mover was absorbed in the frictional resistance of that prime mover and the intermediate parts which carry such movement to the machines required for the purpose of conducting the operations of the factory or shop.

The practice of lubrication is concerned entirely with the reduction of this frictional resistance so as to minimize the expense involved in the power absorbed in this way.

The laws of friction and the consequent considerations of lubrications are quite complex and the science is considerably involved. This may be one of the reasons why the question of efficient lubrication of plants involving moving machinery of various kinds has not been fully considered.

It is to be observed that the careful consideration of the cost of production and the economies to be made in factory equipment of all kinds have been pursued with such vigor that no expense is spared to secure increased efficiency in the mechanical and personal operations of the work. The automatic classes are increased as much as possible and every effort made to avoid duplication and rehandling in the course of production.

In the matter of overcoming the power lost by absorption on account of the friction developed in the moving parts of machinery, experiments have been made and are now being made with types of roller and ball bearings, and other kinds of bearings, etc., which will aid in the reduction of this lost energy.

While this is so much the case that in many plants it is customary to maintain trained specialists whose duty it is to continually experiment and test all kinds of propositions dealing with an increase of efficiency and

economy in production, the matter of lubrication and its effect upon the economy of a plant is less generally understood.

It is the purpose of this book and the succeeding numbers, which will be published at regular intervals, to call attention to the saving which may be effected by careful investigation of the lubricating problem, to give particulars of tests which show the saving effected in various cases which come to our attention and to illustrate the value of Texaco Lubricating Oils in particular, and the care which is taken in supplying the material entirely suited to the conditions of work.

It is hoped that this method of transmitting the information which we secure from time to time, concerning lubrication, will be of interest to those connected with the use of power for all kinds of manufacture and we shall at any time be glad to receive correspondence from all those who are interested in particular tests or subjects mentioned, or who would like further information.

CHARACTERISTICS OF LUBRICANTS FROM VARIOUS CRUDES

Contrary to what has been in some places a general understanding, statement has recently been made by people who are considered as authorities on lubricating oils that better oils can be made from the Texas and Southern Crudes than from the Pennsylvania or Northern Crudes.

However this may be, we have been able by persistent work and by combining the knowledge of a number of competent men to produce a line of lubricating oils, which will not only compare favorably with oils made from other crudes but in a great number of cases give results which are actually surprising.

One of the many reasons for this is the fact that we are able to produce heavy lubricating oils which are made directly from the crude without involving the necessity of mixing lighter oils with heavy cylinder or other stocks.

It has always been known that a so-called "neutral" oil, or one that could be called a straight mineral oil, gave better results from a lubricating standpoint than an oil of the same body which was made up of a mixture of two or three oils.

The mixing of a light oil with a heavy stock oil is absolutely necessary to produce a heavy lubricating oil when working with any crude other than those used by our Company. The use of heavy oil made by our process has brought about results that have been astonishing as well as gratifying.

We have been able to reduce the cost of friction, and maintain better conditions from every point of view by the use of these oils. They contain special characteristics which make them of unusual value for use where temperatures are low as they all have a cold test in the neighborhood of zero.

The oils which we have produced for use in the circulating systems of turbines, especially where the oils will come in contact with water, will stand the most severe service.

We expect to demonstrate these remarks in the tests which will be given in this and succeeding numbers of this magazine. The information will be as exact as possible and such as to illustrate the value of the right kind of lubrication under the conditions mentioned.

In this issue of *Lubrication*, we wish to call attention to the article which we reprint from the Journal of the American Society of Naval Engineers, (May, 1911), describing the performance of the U. S. S. "Delaware," on a recent remarkable cruise. A cruise which excited comment in

all kinds of publications in a number of countries.

This battleship is now returning from the Coronation ceremonies, where it was the largest ship among the representation of the principal Navies of the World. As Americans, we are very proud of the performance of this ship, and as an Oil Company we are no less proud of the fact that during all of the severe service mentioned in the following article, our Texaco Circulation Oil (Heavy), was used as the lubricant for the Force Feed system of the main engines.

—*Editor.*

SOME REMARKS ON THE "DELAWARE" AS A CRUISER BATTLESHIP

By Lieutenant-Commander H. B. Price, U. S. N., Member
(By permission from Journal of American Society of Naval Engineers)

[Note:—The recent remarkable performance of the "Delaware" makes the following account, prepared by her chief engineer, at the request of the editor of the *Journal* of very special interest to our readers. It is needless to remark that no small share of the credit for this performance belongs to Lieutenant Commander Price.—Editor.]

There having been some press comment on the recent full-power trials of the "Delaware," which immediately followed a run to Valparaiso and return, brief mention of a few points in this connection may be of interest.

In the first place, evidently the ship and her machinery were, on the whole, well designed and well built. At all speeds, including the highest, the "Delaware" slips easily through the water, making only a very small wave, and with almost entire absence of vibration.

The hull structure gives a good, rigid support for the engines, evidenced by the fact that, although when coming up the Eastern coast of South America she struck some heavy storms with very rough seas, giving the ship about as much rack and strain as she is ever likely to experience, there were no warm bearings either then or during the subsequent full-power runs.

Having been ordered from Guantanamo Bay to Hampton Roads entirely unexpectedly, to convey to Valparaiso the remains of the late Chilean Minister to the United States, the "Delaware" left Hampton Roads on this mission January 31, 1911.

The run of 4,018 miles to Rio de Janeiro was made at an average speed of 12.02 knots, using 1,022 tons Pocahontas coal. Reached Rio February 16, and left there February 22, 1911. Made the run of 3,832 miles from Rio to Valparaiso at an average speed of 11.18 knots using 1,203 tons of Cardiff coal. This coal, obtained at Rio, was bad, having much refractory clinker that stuck to the grate bars, often causing them to be dislodged in the effort to loosen it, and often forming solid pieces so large that they could not be gotten out of the furnace doors until broken up within. This was very hard on the fireroom force; but was good drill for them, making ordinary firing with standard Navy coal seem easy. On this run a stop of two and one-half days was made at Sandy Point, to exchange visits of courtesy with the Chilean civil and Naval authorities.

Ten days were spent in Valparaiso harbor, and the ship left for home the evening of March 21, 1911. A stop of fifteen hours was made at Sandy Point to obtain fresh provisions. Made the run of 4,012 miles from Valparaiso to Rio at an average speed of 12.82 knots, using 1,493 tons of

very good quality Cardiff coal obtained in Valparaiso.

Stopped at Rio April 4 to 10. Made the run of 4,793 miles to Boston at an average speed of 12.5 knots, using 1,956 tons of good Cardiff coal obtained at Rio.

As the ship was to have several weeks of quiet after reaching New York, it was proposed to run full power for a few hours on April 24, two days before arrival, to see by trial what bearings had best be overhauled. But on the morning of April 24 there was a storm with a very heavy head wind and sea, which it would have been unwise to run into at high speed. So the proposed trial was not run. The next day, the weather having improved, two extra boilers were lighted, making ten out of fourteen in use, and the blowers were put on to hold an air pressure of 1.9 inches of water in the three firerooms in use. The ship ran thus for two and a quarter hours, at a speed of 20.07 knots by revolutions, the engines developing 19,000 I. H. P. This run was made with throttles and stops wide open, the steam consumption being adjusted to steam production by linking up.

The bearings all ran nicely. The distances above given are calculated from revolutions of main engines, so that they are the actual distances and speeds through the water, thus eliminating considerations of effects of currents, etc. Off the coast of Uruguay a severe storm was encountered necessitating deviation from the direct course for about half a day to avoid danger to the steam launches from seas breaking aboard. Even that weather, however, would not have seriously interfered with the working of turret guns; and there was practically no racing or racking of the engines.

The "Delaware" had orders to dock at Boston immediately upon arrival and then go to the New York yard for a month, to have some minor changes in quarters, etc., made in preparation for attending the Coronation ceremonies. No one on board had any intimation of a change in these plans until about 5:00 A. M., April 26, when a wireless message was received, directing that, if feasible, the "Delaware" coal at once and immediately proceed on a four-hour full-power trial, followed continously by a twenty-hour full-speed endurance run. The ship entered Boston harbor at high tide that forenoon, anchoring about 10:30. Four coal lighters were immediately put alongside, coaling gear was rigged, and during the afternoon the ship took 998 tons of ordinary run-of-the-mine coal. Anticipating docking, the reserve feed tanks were nearly empty, and the evaporator plant was secured for scaling and overhauling. Fresh water was requested of the Navy Yard; but about the middle of the afternoon it was ascertained that the Boston Yard had no water barge and could give the ship no water. The four evaporators were started, and made about 90 tons fresh water, which was enough for the trials and subsequent high-speed standardization runs.

The ship was in Boston harbor 22½ hours, leaving next morning, April 27, at 9:00 A. M.—as early as the tide would serve. During this time, no examination or adjustment whatever was made about the main engines or auxiliaries, except the ash expellers. The men not coaling ship concentrated their efforts on cleaning fire sides of boilers and getting ash expellers in working order. It was necessary to keep fires in two boilers for auxiliaries and evaporators, so they could not be well cleaned. The men, except those on auxiliary watch, were given a chance for an uninterrupted night's sleep.

The ship left Boston harbor under six boilers, the cleaning of the other eight being still in progress. These

were lighted as they were ready, and by 2:42 P. M. all fires were built up heavy and the full-power trial was begun, with the engines running 128 revolutions. This was soon improved, as fires were green at the start, and the average for the four hours was 131.02 r. p. m. There is no definitely established point that high on the ship's official speed-revolution curve; but it gives a speed of about 21.85 knots average for the four hours. The run was continued, with 2 inches air pressure in the firerooms, for twenty hours more.

The average speed for the twenty-four hours was 21.32 knots by the last official curve.

The contract speed of the "Delaware" was 21 knots. This performance seems satisfactory, as it represents strictly service conditions, the orders for a full-speed run having come as an entire surprise to everbody, when it was expected that the ship would dock in accordance with orders already on board.

There had been no opportunity to clean the watersides of boilers since leaving Norfolk in January; yet the boilers steamed freely, and for much of the time the forced-draft blowers were run below full speed to avoid having more than the allowed air pressure in the firerooms.

No special preparation has at any time been used in the boilers. Water from each steaming boiler is tested every morning for salt and acid, and lime water is used to preserve a slight alkalinity.

There was not a single hot bearing or any derangement of main engines or auxiliaries during these full-speed trials and the standardization runs, which followed.

On the conclusion of the twenty-four-hour endurance run the ship slowed down to clean fires well while entering Penobscot Bay. This done, she at once proceeded with the high speed standardization runs over the Rockland course. Though the depth there is from 45 to 80 fathoms, the engines would make only 130 revolutions with everything wide open and safety valves lifting, while at sea during the full-power run, they made 132 revolutions under the same condition.

The men stood a watch in three, and there was one fireman and one coal passer for each pair of furnaces, as in ordinary cruising half the number employed by the contractors on their full-speed trial of the ship. The firing timing device which is habitually used on the "Delaware" was set at one minute and thirty seconds; and this rate required 7 to 8 shovels of coal per charge. Furnaces were fired and raked alternately, as is customary.

After twelve hours' steaming the customary routine cleaning of fires was begun; that is, cleaning one fire in each boiler per watch, or a total of fourteen per watch. Considerable speed was lost by failure to begin cleaning fires at least four hours earlier. They were very dirty, and it was necessary to haul everything out of each furnaces cleaned.

No fuel oil was burned during these full-speed runs, as it did not seem needful, and it was thought better to run the trials burning coal only as a comparative demonstration of the ship's steaming capability.

The "Delaware" has burned oil under varying conditions, including a full-speed run of four hours, two days' steaming in fleet during maneuvers, burning oil only; has used it during the target-practice period to effect the quick changes of steam generation then wanted, without loss; has burned oil in conjunction with coal; has burned oil only, in port, for several months. Full reports have been made to the Navy Department relative to oil burning under various conditions.

There were several things contributory to this comparatively successful steaming of the "Delaware." In the

first place, as stated above, machinery and ship are well designed and well built. The forced-lubrication system on the main engines saves the bearings from wear if they are kept reasonably well adjusted. This is the great military advantage of forced lubrication. Saving of oil is a secondary matter, as any ship can easily carry comparatively large amounts of lubricating oil.

On the "Delaware," the lubricating oil economy is not marked, and at full speeds there is much waste of oil, which will be improved upon. But the economy in the wear of bearings and the consequent general readiness and reliability of the ship for service, is very marked.

In the harbors of Rio and Valparaiso, such needed adjustments and overhauling were done as was compatible with the crew's liberty ashore. It may be stated, both as to machinery and to personnel, that the "Delaware" has been very free from any slackness and from any friction. The men all have a pride in their ship and an interest in their work, and in that lies a big element of successful accomplishment. A co-ordination of effort, a spirit of mutual helpfulness and consideration of one another's problems and difficulties, a careful adaptation of routine, among officers and men of all departments, is a very real element of military efficiency.

During the three months of this South American voyage, the only thing bought in the way of machinery supplies was a few ½-inch rivets which were found to be unfit to use. Some fresh water was bought in Rio, because it was convenient and it was cheaper to buy it than to use 50-shilling coal to distill it. The only other items of purchase were coal and provisions.

The "Delaware" is fitted to carry an ample supply of lubricating oil for a cruise around the world without renewal.

Her foundry and machine shop, copper shop and blacksmith shop, have been able to do all the ordinary work requisite to make the shop self-supporting in the matter of repairs. A fuel-oil forge is used for the heavier work in copper and blacksmith shops. The foundry uses fuel oil, of course. It has made castings of iron, brass, composition, aluminum, babbitt metal and solder.

The "Delaware" is fortunate in having an excellent crew of men who like their ship, including men skilled in nearly every trade.

HEAVY DUTY TEST

For the proper lubrication of large vertical blowing engines and pumps very heavy, greasy oil is required, as the entire weight of the reciprocating parts of the shaft and wheels comes upon the bearings. Speeds are slow and the temperature of the room is usually moderate. It is sometimes considered necessary to use cylinder oil or cylinder stock for these bearings as it is appreciated that the service is unusually severe, and it is necessary to have a very heavy lubricant to properly stand the pressure.

Under these rather severe conditions, a test was made with Texaco oil; the temperatures of the room and of both the main bearings were taken.

The following table will show the result:

TEMPERATURE TEST UPON THE TWO MAIN BEARINGS OF A VERTICAL BLOWING ENGINE RUNNING 30 R. P. M.

	Room Average	Right Bearing	Frictional Heat	Left Bearing	Frictional Heat
Former oil, Mar. 25	92°F.	105°F.	13°F.	105°F.	13°F.
Texaco oil, Apr. 3	90°F.	101°F.	11°F.	99°F.	9°F.
Total reduction of frictional heat by using Texaco oil.....			2°F.		4°F.
Reduction in per cent			15.4%		30.4%

It is a matter of considerable satisfaction to us to be able to manufacture oil which under these conditions will show such good results.

A CONSIDERABLE SAVING EFFECTED IN THREAD-CUTTING WORK

The question of a suitable cutting oil is one that means much to the plant for which it is a necessity. Cutting oils are numerous. Not content with the many different brands offered by the oil sellers, many operators mix those bought or else purchase supplies of lard and other oils and mix according to their own ideas, making the oil thin with kerosene or heavy with cylinder oil; in every case evidently doing whatever work is necessary to the satisfaction of those in charge. The output of a machine fitted with cutting tools is dependent to a large extent upon the oil used to keep the dies lubricated and cool. A poor oil will allow the tool or die to heat up, dulling the tool and causing the thread to strip and become roughened. If the oil is very poor or has become worn out, the speed of the machine must be lowered, otherwise the work is not up to gauge and the dies will be quickly spoiled.

Cases are within the experience of every shop manager where it has been necessary to reduce the speed of all tools in order to compensate for the use of a poor cutting oil. Shop managers have also experienced the necessity of discontinuing the use of cutting oil on account of its rancidity and on account of the irritation caused to the workmen's hands by having to work in the oil.

It is common knowledge that a very good cutting oil will allow good

speed and output, and, covering a period of days and weeks, an increased output due to the fact that the dies remain sharp and that no time is lost in making the necessary change of tools.

It is, therefore, very interesting to be able to note the details of a test made upon our Texaco Cutting Oil, taking as the basis of the test the temperature of the die and measuring this by taking the temperature of the oil before going on and after coming from the die. The former oil showed an increase of 95.1°F. with dies which had been in service for some little time. With the same oil the dies were changed and at the same speed the difference in temperature between the oil going on and coming from the die was 84°. The difference of 11.1° is the exact difference between a dull and sharp cutting tool. Changing to Texaco Cutting Oil brought about reduction in temperature of 40.7° or a saving of 48%, as shown by the following table:

CUTTING OIL TEST 2-INCH PIPE.

	R. P. M. of die	Pipes thr'd. per hour	Temperature Deg. F. Room	Oil going on die	Oil from die	Rise (Difference)
Former Cutting Oil,						
Old dies	27	32	63°	61.5°	156.6°	95.1°
New dies . . .	27	32	57.3°	60.6°	144.6°	84.0°
Texaco Cutting Oil .	27	32	67°	59.5°	102.8°	43.3°

Rise in temperature former oil (new dies) . . . 84.0°F.
Rise in temperature, Texaco Oil . . . . . 43.3°F.
Reduction . . . . . 40.7°F. or 48.0%

After these good results were shown on this machine, the same test was made on a machine threading $5\frac{3}{16}$ inch pipe. The reduction in temperature amounted to 7.44%. Details are as follows:

CUTTING OIL TEST, $5\frac{3}{16}$-INCH PIPE.

	R.P. M. of die	Pipes thr'd per hour	Temperature Deg. F. Room	Oil going on die	Oil from die	Rise (Difference)
Former Cutting Oil . . .	14	17	52°	60°	114.8°	54.8°
Texaco Thread Cutting . .	14	18	54°	61°	111.8°	50.8°

Rise in temperature, former oil . . . . . 54.8°F.
Rise in temperature, Texaco Oil. . . . . 50.8°F.
Reduction . . . . . 4.0°F. or 7.44%

From these two tests it would appear that on work, particularly on all pipes under 10 inches, there would be a certain degree of efficiency which could be obtained by the use of our Thread Cutting Oils. The efficiency would increase with the reduction in the size of the pipe.

The price of pure winter strained lard oil is in the neighborhood of $1.10 per gallon. The variations of lard oil are many and the oil which is commercially possible for cutting tools can be bought from 60c. to 80c.; these high prices greatly limit the use of the best quality of lard oil.

The oils which are largely used by machine shops can be displaced with our Texaco Thread Cutting Oils with considerable economy, not only in regard to price but in improved operation.

Considering the test on the 2-inch pipe, it would be possible to increase the speed of this machine and secure greater output. In fact, the speed of the machine could be increased so that the temperature of the oil coming from the dies would be the same as with the old oil. In this way the life of the die would be the same, but there would be a largely increased amount of work accomplished. But, should the cost of the die be considerable the output could be maintained at the same point as with the old oil and the life of the die be used to figure the lessened operating cost with the new oil.

In making thread cutting oils, it is necessary to have a wide knowledge as to the proper blending and mixing of oils of different natures, as it is necessary to combine various oils to produce as near as possible the characteristics of a lard oil without any of the drawbacks, which, in the case of the cheaper commercially possible lard oils, is offensive odor, which comes from rancidity, or the adulteration of the oil with drying oils or oils which rapidly oxidize. When these latter oils are used the machine becomes gummed up and it is necessary in some cases to thoroughly flush out with kerosene on Monday morning before starting work.

FRICTIONAL HEAT REDUCTION

Lubricating oil is used for the purpose of reducing friction. The simplest way of finding out the value of one oil as against another is to determine whether its use shows any reduction in friction. One of the indications of friction in a bearing is heat. This heat is not due entirely to the metals rubbing against each other, but is largely due to the working of the oil,—to what is termed "fluid friction." If an oil lubricates well the friction—and consequently the temperature—of the bearing is at a minimum; if the oil lubricates better than another oil the temperature of the bearing is not as high, as the lost energy (which is being transformed into heat) has been reduced.

For a comparison it is well to take the temperature of the bearing and the temperature of the room. The difference between these two readings is the temperature due to friction. This friction temperature usually remains constant with the same speed, load, kind and amount of oil. It varies, but not directly, with the temperature of the room. With all conditions the same, but with a change in oil, the temperature will decrease with a suitable and increase with an unsuitable lubricant.

The following test illustrates this and shows the good results obtained by the use of our Texaco oil. The test was made on the main guide of a rolling mill engine. The temperature of the room was taken in the neighborhood of the engine and the temperature of the guide was taken by placing the thermometer directly on the guide. The Texaco oil was in use on this engine for some days and on May 15th temperature test was taken which shows 13.50 degrees F. frictional heat. The former oil was then placed on the engine and the next morning the temperature test was started, the average for the day being 14.62° F. This shows a reduction in favor of Texaco oil of 7.65% in the frictional heat. The details in regard to this temperature test follow:

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TEMPERATURE TEST ON THE MAIN GUIDE OF A ROLLING MILL ENGINE.

	Time a.m.	Room Temperature	Guide Temperature	Frictional Heat
Former Oil, May 16, '11 . .	7:00	86.5°F.	102°F.	15.5°F.
	8:00	85.5	100	14.5
	p. m.			
	1:00	97.5	112	14.5
	1:30	98.0	112	14.0
				14.62°F.
	a.m.			
Texaco Oil, May 15, '11, . .	7:00	77°F.	92°F.	15°F.
	8:00	84	96	12
	p. m.			
	1:00	97	110	13
	1:30	96	110	14
				13.50°F.

Frictional heat of Main Guide, using former oil.....	14.62°F.
Frictional heat of Main Guide, using Texaco Oil....	13.50°F.
Reduction of frictional heat	1.12°F. or 7.65%

OIL EFFICIENCY

Lubrication plays a large part in the cost of running a plant, although the amount paid for oil per year is probably one of the smallest items connected with the cost, usually being between two and seven per cent. of the total expenditure for other supplies.

The important part is not the cost of the oil itself, but the efficiency to be gained from the use of a good oil, or the damage occasioned by a poor or unsuitable oil.

This point is well illustrated by the result of a test upon a skelp mill. This mill is composed of eleven trains of rolls, each roller being 10 to 12 inches in diameter, from 25 to 44 inches long and varying in weight from 180 to 570 pounds, with the pinions, to 1200 pounds. The speed of the various rollers is from 210 to 510 R.P.M. Before making a test the bearings of the rollers were all examined and it was found that the bearing for Roller No. 10 was unusually hot. This roller is 10 inches in diameter and, with the 39 inch pinion, weighs half a ton. The temperature of the bearing was 172½°F. The babbitt on the main bearing had been burned out four times during the last sixteen months. This roll was considered a very difficult place on which to make a test of lubricating oil.

The test was made by taking the temperature of the room in the neighborhood of the bearing and the temperature of the bearing, with the speed of the roll. The oil which was in service had been used for some time and while it was a very good lubricant, it was not entirely suited to this particular case.

Test on the former oil was started at nine o'clock and at eleven thirty, after six readings had been made, the average temperature of the bearing above the temperature of the room was 109.8°F. During the noon hour the oil was changed to our Texaco Oil. The temperature of the bearing at the first reading was 108° or 1.8° under the average of the morning. During all subsequent readings of the instruments, temperature gradually decreased until at five fifteen the temperature due to friction registered 47°F. which was a reduction of 57.5% below the average shown by the other oil during the morning test. Three

days later, readings taken during the morning gave an average of 36°F. frictional temperature on these same bearings. This is a reduction of 67.2% from the average temperature with the former lubricant. Before taking the last series of readings, a small plate was fixed in the bearing which prevented the oil from flowing away too rapidly, and this caused a further improvement of about 10%. For comparative purposes it would be fair for us to consider that the Texaco Oil gave a reduction of 62.8°F. or 57.5%.

The total readings with summary are as follows:

			Temperatures Deg. F.		
	Time a.m.	R.P.M. Roller	Room	Bearing	Frictional Heat
Mar. 31,					
	a.m.				
Former oil (a very heavy "good but misplaced" oil).	9:00	270	62°	172°	110°
	9:30	270	62°	173°	111°
	10:00	270	63°	172°	109°
	10:30	270	63°	173°	110°
	11:00	270	63°	172°	109°
	11:30	270	63°	173°	110°
Oil changed at 12:30.					109.8°
Mar. 31.					
Texaco Oil (a very heavy and fine lubricant.)	1:00	270	64°	172°	108°
	1:30	270	64°	162°	98°
	2:30	270	64°	142°	78°
	3:30	270	64°	129°	65°
	4:30	270	64°	124°	60°
	5:15	270	64°	111°	47°
	a.m.				
Texaco Oil, with slight adjustment, to bearing.	7:00	270	69°	104°	35°
	7:30	270	69°	104°	35°
	8:00	270	68°	104°	36°
	8:30	270	68°	104°	36°
	9:30	270	67°	104°	37°
	10:00	270	67°	104°	37°
				Average	36°

Average frictional temperature with former oil	109.8°F.
Temperature after using Texaco Oil for five hours	47.0
Reduction	62.8°F. or 57.5%
Average frictional temperature after 3 days use of Texaco Oil	36.0°F.
Reduction from average with former oil	73.8°F. or 67.2%

THE RIGHT OIL
IN THE RIGHT PLACE

THIS practically sums up the science of economical lubrication, save to add that the quantity, also, must be carefully watched. A large amount of oil does no more work and is only so much waste.

You know the "right place," but do you know the "right oil?"

Should you learn that certain oils were prepared after exhaustive study and practical experiment, taking into consideration all the varying conditions of speed, pressure and heat, wouldn't you be inclined to think that such oils were "right"—particularly when they are demonstrating their efficiency and quality in every-day service? These are the oils that make up the list of

Texaco Lubricating Oils

It includes Texaco Cylinder Oils, Engine and Machine Oils, Gas Engine Oils, Railway Oils, Special Oils, Black Oils, Greases, Solid Lubricants, etc.

They are made for all conditions, and all of them are of the highest efficiency. They are unsurpassed for quality and service. They reduce running expenses.

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